

Structure of Molecules

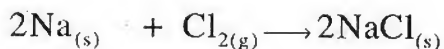
Long Answer Questions

Q1. Define Ionic bond. How Ionic bond is formed in sodium chloride?

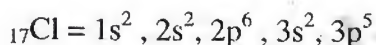
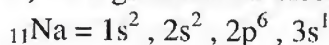
Ans: Definition

“A bond formed due to transfer of electron from one atom to another atom, is called ionic bond”.

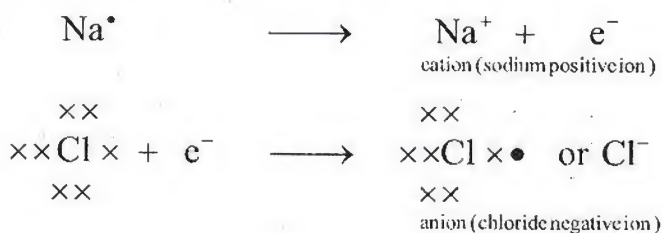
Formation of sodium chloride



Sodium chloride is a simple compound formed from sodium ($Z=11$) and chlorine ($Z=17$). The ground state electronic configuration of these elements is shown below:



This shows that sodium has only one while chlorine has seven electrons in their valence shells. Sodium has the tendency to lose valence shell electron and form a positive ion, while chlorine has the tendency to gain an electron in its valence shell to form a negative ion.



When sodium loses one electron it forms a Na^{+} ion, while Cl^{-} is formed when chlorine gains that electron. Both these atoms are now oppositely charged ions. They stabilize themselves by combining with each other due to electrostatic force of attraction between them and a low energy state. ($\text{Na}^{+} + \text{Cl}^{-} \longrightarrow \text{NaCl}$)

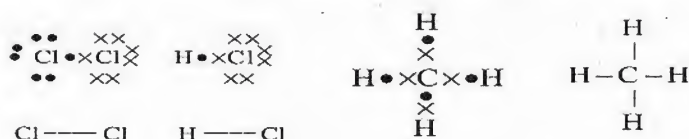
Q2. What is Covalent Bond? Explain its different types with examples.

Ans. Covalent Bond:

“A bond which is formed due to mutual sharing of electrons is called covalent bond”.

i. Single Covalent bond (-)

Examples of molecules with single covalent bonds are hydrogen (H_2), chlorine (Cl_2), methane (CH_4) etc.



When each bonded atom contributes two electrons, two bond pairs are shared and a double bond is formed. It is indicated by (=).

$$\begin{array}{c} \bullet \bullet \\ \text{O} \bullet \\ \bullet \bullet \end{array} + \begin{array}{c} \times \times \\ \times \text{O} \\ \times \times \end{array} \longrightarrow \begin{array}{c} \bullet \bullet \\ \text{O} \bullet \\ \bullet \bullet \end{array} \begin{array}{c} \times \times \\ \times \text{O} \\ \times \times \end{array} + \text{O} + \text{O} + \text{O}_2$$


When each bonded atom contributes three electrons, three bond pairs are shared and a triple bond is formed. It is indicated by (\equiv).

$$\cdot\ddot{\text{N}}\cdot + \begin{array}{c} \times \\ \times \times \times \\ \times \times \times \\ \times \end{array} \longrightarrow \begin{array}{c} \cdot \times \\ \cdot \times \times \\ \cdot \times \times \\ \cdot \times \end{array} \text{ or } \text{N} \equiv \text{N} \text{ or } \text{N}_2$$


Ans: Definition

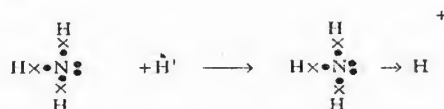
“Coordinate covalent or dative covalent bonding is a type of covalent bonding in which the bond pair of electrons is donated by one bonded atom only”. It is also known as Dative covalent bond?

Concept of donor and acceptor

An atom which donates the electron pair is called donor and an atom which accepts the electron pair, is called acceptor. A small arrow (\rightarrow) is usually used to indicate the formation of coordinate covalent bond. The arrow head will toward an atom which usually accepts the electron.

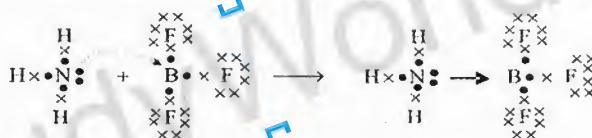
Formation of coordinate covalent bond in NH_4^+ radical

Nitrogen from ammonia molecule donates its lone pair of electrons to H^+ in order to form a coordinate covalent bond.



Formation of coordinate covalent bond between NH_3 and BF_3

Nitrogen from ammonia molecule donates its lone pair of electrons to the boron of boron trifluoride molecule in order to form a coordinate covalent bond.



Q4. Differentiate between polar and non-polar covalent bond

Ans.

Non-polar covalent bond	Polar covalent bond
A covalent bond is formed between two similar atoms (homo-atoms), the shared pair of electrons is attracted by both the atoms equally.	A covalent bond is formed between two different types of atoms (hetero-atoms) then the bond pair of electron will not be attracted equally by the bonded atoms.
These bonds are formed by equal sharing of electron pair between the two bonding atoms having same electronegative values.	These bonds are formed by equal sharing of electron pair between the two bonding atoms having different electronegative values.
This type of bond is called a pure covalent bond.	This type of bond is called an impure covalent bond.
Example: The bond formation in H_2 , Cl_2 , O_2 , N_2 etc.	Example: The bond formation in CO_2 , HCl , HF , H_2O etc.

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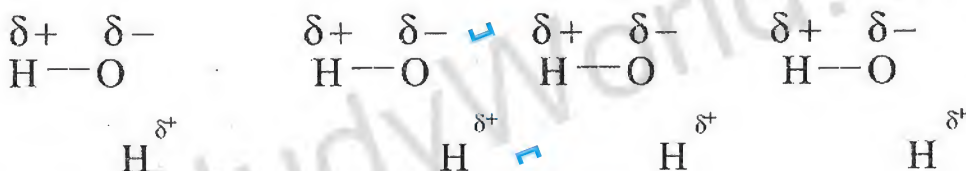
Q5. Write a note on hydrogen bonding.**Ans. Definition**

“The force of attraction between partially positive hydrogen atom of one molecule and highly electronegative atom of another molecule is called hydrogen bonding”.

Explanation

Hydrogen bonding is a special type of intermolecular forces present in the permanently polar molecules. This bonding can be considered unique dipole- dipole attraction. This force of attraction develops between molecules that have a hydrogen atom bonded to a small, highly electronegative atom with lone pairs of electrons such as nitrogen, oxygen and fluorine. The covalent bond between hydrogen atom and other atom becomes polar enough to create a partial positive charge on hydrogen atom and a partial negative charge on the other atom. The small size and high partial positive charge on the hydrogen atom enables it to attract the partially negative lone pair on the N, O or F atom of the other molecule.

Hydrogen bonding is the force of attraction which is represented by a dotted line between the molecules as shown below:

**Q6. Different between ionic and covalent compounds.****Ans. Ionic Compound****Covalent bond**

i. They consist of positive and negative ions	i. They are neutral
ii. They exist in solid state.	ii. They exist in solids liquids and gases.
iii. They have high melting and boiling points.	iii. They have comparatively low melting and boiling points.
iv. Strong forces of attractions are present between their particles.	iv. Weak forces are present between their particles.
v. They have definite shape.	v. They have no definite shape.
vi. They are formed usually when metal react with non-metals.	vi. They are formed usually when non-metal reacts with non-metals.
vii. Examples are: Sodium chloride, potassium chloride etc	vii. Examples are: glucose, benzene etc

Q.7. Write a note on Metallic Bond.**Ans. Metallic Bond**

The metallic bond is defined as a bond formed between metal atoms (positively charged ions) due to mobile or free electrons.

Explanation

In case of metals, the hold of nucleus over the outermost electrons is weak because of large sized atoms and greater number of shells in between nucleus and valence electrons. Furthermore, because of low ionization potentials, metals have the tendency to lose their outer electrons easily. Resultantly, these loose or free electrons of all metal atoms move freely in the spaces between atoms of a metal. None of these electrons is attached to any particular atom. Either they belong to a common pool, or belong to all the atoms of that metal. Nuclei of metal atoms appear submerged in sea of these free mobile electrons. These mobile electrons are responsible for holding the atoms of metals together forming a metallic bond. A simple metallic bond is shown in figure.

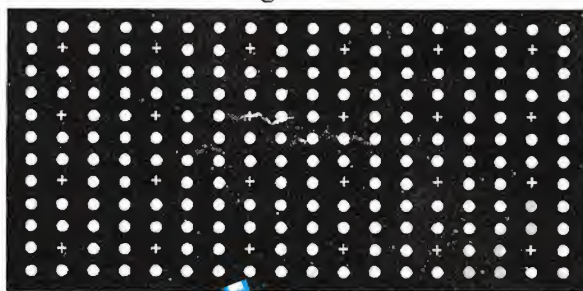


Fig. A schematic diagram of copper wire showing its positive nuclei (+) embedded in sea of free electrons (o) making Metallic bonding

Short Answer Questions

Q.1. Why atoms form a chemical bond?

Ans. Atoms form a chemical bond to achieve stability by acquiring inert gas electron configuration.

Q.2. Why noble gases are non-reactive in nature?

Ans. The noble gases do have 2 or 8 electrons in their valence shells. It means that all the noble gases have their valence shell completely filled. Their atoms do not have vacant space in their valence shell to accommodate extra electrons. Therefore, noble gases do not gain, lose or share electrons. That is why they are non-reactive, at ordinary conditions.

Q.3. How an atom can accommodate eight electrons in its valence shell?

Ans. An atom can accommodate eight electrons in its valence shell in three ways

- By giving valence shell electrons (if they are less than four) to other atoms
- By gaining electrons from other atoms (if the valence shell has five or more electrons in it)
- By sharing valence electrons with other atoms

Q.4. When atoms are considered to be unstable?

Ans. The atoms having less than 2 or 8 electrons in their valence shells are unstable.

Q.5. What is the mode of reaction of an atom with reference to their group?

Ans. Mode of reaction of an atom depends upon its number of valence shell electrons. For example, group I has only 1 electron in its valence shell and group 17 has 7 electrons in its valence shell.

Q.6. What is meant by a chemical bond?

Ans. A force of attraction between atoms that holds them together in a molecule is called a chemical bond.

Q.7. What is meant by duplet rule?

Ans. The attaining of two electrons in the outermost shell by sharing, by losing or by gaining electrons is called duplet rule.

Q.8. What is meant by octet rule?

Ans. The attaining of eight electrons in the outermost shell by sharing, by losing or by gaining electrons is called octet rule.

Q.9. What would be the effect, when two approaching atoms come closer to each other?

Ans. When two approaching atoms come closer, the attractive as well as repulsive forces become operative.

Q.10. What is the effect of attractive and repulsive forces in the formation of a chemical bond?

Ans. If attractive forces become dominate, the decrease in the energy of the system takes place, due to which chemical bond is formed. While, if repulsive forces become dominate, the increase in the energy of the system takes place, due to which no chemical bond is formed.

Q.11. What is meant by bonding electrons?

Ans. The valence electrons, which are involved in chemical bonding, are termed as bonding electrons.

Q.12. Name different types of chemical bonds

Ans.

- | | |
|---------------------------------|--------------------|
| (i) Ionic bond | (ii) Covalent bond |
| (iii) Co-ordinate covalent bond | (iv) Metallic bond |

Q.13. Define ionic bond

Ans. The bond formed by the complete transfer of electrons from one atom to another is called ionic bond.

Q.14. What is meant by covalent bond?

Ans. The bond formed by the mutual sharing of pairs of electrons is called covalent bond.

Q.15. What is meant by single covalent bond? Give example.

Ans. When one electron is contributed by each bonded atoms, one bond pair is formed and it forms a single covalent bond. It is represented by (—). A few examples of molecules with single covalent bonds are hydrogen, chlorine, hydrochloric acid, methane etc.

Q.16. What is meant by double covalent bond? Give example.

Ans. When each bonded atom contributes two electrons, two bond pairs are shared and a double covalent bond is formed. It is represented by (=). A few examples of molecules with double covalent bonds are oxygen, ethene etc.

Q.17. What is meant by triple covalent bond? Give example.

Ans. When each bonded atom contributes three electrons, three bond pairs are involved in bond formation. This type is called triple covalent bond. It is represented by (\equiv). A few examples of molecules with triple covalent bonds are nitrogen, ethyne etc.

Q.18. What is meant by bond pair?

Ans. The electrons that pair up to form a chemical bond is called bond pair electrons.

Q.19. What is meant by lone pair?

Ans. A non-bonded electron pair available on an atom is termed as lone pair of electron.

Q. 20. Describe Lewis structure diagram.

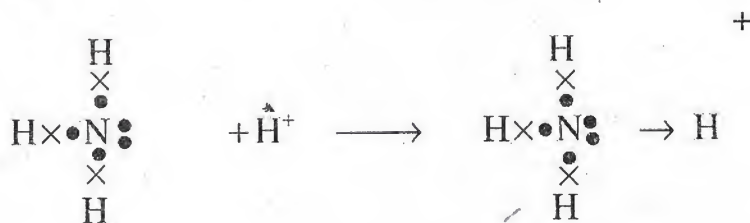
Ans. The electronic configuration of the valence shells of atoms is shown in small 'dots' or 'crosses' around the symbol of the element. Each dot or cross represents an electron. This is a standard method of Lewis to describe the electronic configuration of valence shell of an atom. It is called Lewis structure diagram.

Q.21. Define coordinate covalent bond.

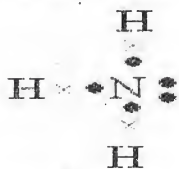
Ans. A type of covalent bond in which the bond pair of electrons is donated by one bonded atom only is called coordinate covalent or dative bond.

Q.22. How coordinate covalent bond is formed in NH_4^+ ?

Ans.



Q.23. Draw Lewis dot structure of ammonia.



Q.24. Draw Lewis dot structure of nitrogen.



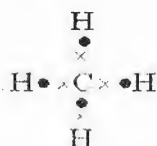
Q.25. How coordinate covalent bond is formed between NH_3 and BF_3 ?

Ans.



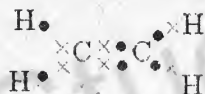
Q.26. Draw Lewis dot structure of methane.

Ans.



Q.27. Draw Lewis dot structure of ethane.

Ans.



Q.28. Draw Lewis dot structure of ethyne.

Ans.



Q.29. What is meant by non-polar covalent bond? Give example.

Ans. If a covalent bond formed between two similar atoms, the shared pair of electrons is attracted by both atoms equally. Such type of bond is called non-polar covalent bond. A few examples of molecules with non-polar covalent bonds are hydrogen, chlorine, nitrogen etc.

Q.30. What is meant by polar covalent bond? Give example.

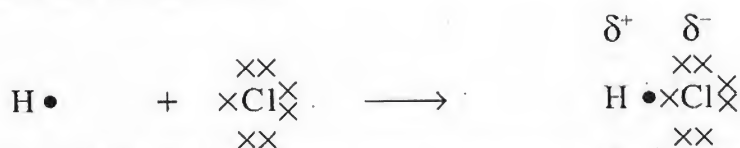
Ans. If a covalent bond formed between two different types of atoms, then the bond pair of electrons will not be attracted equally by the bonded atoms. Such type of bond is called polar covalent bond. A few examples of molecules with polar covalent bonds are hydrochloric acid, water etc.

Q.31. What is meant by electronegative atom?

Ans. The atom will attract the bond pair of electrons more strongly than the other one during polar covalent bond formation. This atom will be called as more electronegative atom as compared to the other bonded atom. For example, in HCl molecule Cl is more electronegative atom as compared to H atom.

Q.32. Give the formation of polar covalent bond in HCl molecule.

Ans. The difference between electronegativities of hydrogen and chlorine is 1.0. As the electronegativity of chlorine is more, it attracts the shared pair of electron towards itself with a greater force. A partial negative charge is therefore created on chlorine and in turn a partial positive charge on hydrogen due to electronegativity difference. It creates polarity in the bond and is called a polar covalent bond.



Q.33. What do you mean by delta sign and why it develops?

Ans. The delta (δ) sign indicates partial positive or partial negative charge that is developed due to unequal sharing pair or bonded pair of electrons.

Q.34. What is the effect of electronegativity in the formation of an ionic bond?

Ans. By using electronegativity values, it is possible to predict whether a chemical bond will be ionic or a covalent in nature. A bond formed between elements of high electronegativity (halogen group) and elements of low electronegativity (alkali metals) are ionic in nature.

Q.35. How electronegativity values help us to predict the formation of a chemical bond?

Ans. If the difference of electronegativities between two elements is more than 1.7 the bond between them will be predominately ionic bond and if it is less than 1.7, the bond between two atoms will be predominately covalent.

Q.36. What is meant by metallic bond?

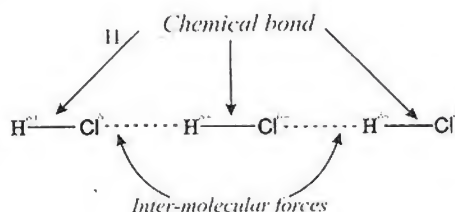
Ans. A bond formed between metal atoms (positively charged ions) due to mobile or free electrons is called metallic bond.

Q.37. What is meant by intermolecular forces?

Ans. A weak force of attractions formed between two molecules is called intermolecular forces

Q.38. Show the bonding and intermolecular forces in HCl molecule.

Ans.

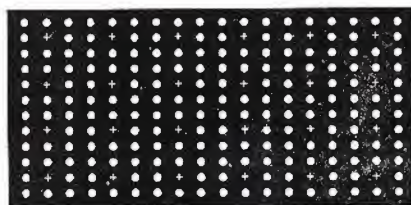


Q.39. What is meant by Van der Waals forces?

Ans. All intermolecular forces, which are collectively called Van der Waals forces, are electrical in nature. They result from the attractions of opposite charges which may be temporary or permanent.

Q.40. Draw a schematic diagram of copper wire showing metallic bonding.

Ans.



Q.41. How dipole-dipole interactions are found in HCl molecule?

Ans. When partial positive and partial negative charges exist at different positions in a molecule, the adjacent molecules will arrange themselves in such a way that negative portion of that molecule come near to positive portion of other molecule. It results in net forces of attraction between oppositely charged portions of two adjacent molecules. These attractive forces are called dipole-dipole interactions as represented in HCl

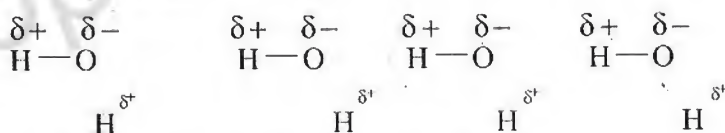


Q.42. What is meant by hydrogen bonding?

Ans. A bond formed between partially positive hydrogen atom of one molecule with partially negative atom of the other molecule is called hydrogen bonding.

Q.43. Draw a structure of water molecules showing hydrogen bonding.

Ans:

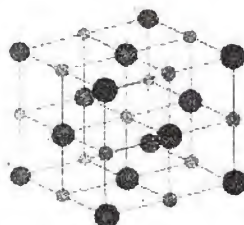


Q.44. Why ice floats on the surface of water?

Ans. At 0°C ice has a lesser density (0.0917 g/cm³), than water (0.100 g/cm³), due to which ice floats on the surface of water.

Q.45. Describe the regular arrangement of Na⁺ and Cl⁻ ions in solid crystal of NaCl.

Ans.



Q.46. What are ionic compounds? Give example.

Ans. Those compounds which contain ionic bond in them are known as ionic compounds.
e.g., NaCl, KCl etc.

Q.47. Write any two properties of ionic compounds.

Ans. (i) They are made up of positively and negatively charged ions.

(ii) They consist of ions not the molecules.

Q.48. Ionic solids are good conductors of electricity. Why?

Ans. Ionic solids are good conductors of electricity only in solution and in the molten form due to the presence of free ions in them.

Q.49. When covalent compounds are considered to be a good conductor of electricity?

Ans. They are considered to be good conductors of electricity due to having polar character in their bonding when they are dissolved in polar solutions.

Q.50. Why coordinate covalent compounds do not form ions in water?

Ans. They do not form ions in water because the nuclei in these compounds are held by shared electrons.

Q.51. What is meant by malleability and ductility?

Ans. Malleability is the property by virtue of which a metal can be drawn into sheets, while ductility is the property by virtue of which a metal can be drawn into wires.

Q.52. Name polymers or resins used in synthetic adhesives.

Ans. i. Thermoplastics ii. Thermosets

Q.53. Give composition of epoxy.

Ans. Epoxy is a polymer that is formed from two different chemicals

i. Resin ii. Hardener

Q.54. Give uses of adhesives.

Ans. These high performance adhesives are used in the construction of

i. Aircrafts ii. Automobiles iii. Bicycles
iv. Boats v. Golf clubs etc

Q.55. What are the applications of epoxy adhesives?

Ans. They can be made flexible or rigid, transparent or opaque, colored as well as fast or slow setting.

Q.56. What properties show presence of different types of chemical bond between atoms of metals?

Ans. The different properties shown by metals such as high melting and boiling points, good conduction of heat and electricity, hard and heavy nature, suggest existence of different type of chemical bond between atoms of metals.

Q.57. How metallic bond is formed?

Ans. In metals, the hold of nucleus over the outermost electrons is weak because of large sized atoms and greater number of shells in between nucleus and valance electrons. Because

of low ionization potentials, metals have the tendency to lose their outer electrons easily. Due to which, these loose or free electrons of all metal atoms move freely in the spaces between atoms of a metal. The nuclei of metal atoms appear submerged in sea of free mobile electrons. These mobile electrons are responsible for holding the atoms of metals together forming a metallic bond.

Q.58. Differentiate between polar and non-polar compounds

Ans.

Polar compounds	Non-polar compounds
i. They are soluble in water	i. They are insoluble in water
ii. They are insoluble in non-polar solvents like benzene, petrol etc	ii. They are soluble in non-polar solvents like benzene, petrol etc
iii. They can conduct electricity in the form of aqueous solution	iii. They do not conduct electricity
v. Examples are: HCl, HF	v. Examples are: CH ₄ , C ₂ H ₂

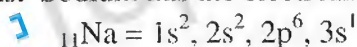
Q.59. Why does sodium form a chemical bond with chlorine?

Ans. Sodium forms a chemical bond with chlorine due to the following reasons

- Sodium has the tendency to lose one electron and chlorine has the tendency to gain one electron. This favors the transference of electrons and hence ionic bond is formed.
- Sodium is electropositive and is at high energy state whereas chlorine is electronegative and is at low energy state. This energy difference favors the formation of ionic bond between them.

Q.60. Why sodium does lose an electron and attains +1 charge?

Ans. Sodium has the electronic configuration as follows



Hence, it is better and easier for sodium to lose one electron and complete its valence shell rather than gaining seven electrons to complete the octet.

Q.61. How do atoms follow octet rule?

Ans. Most of the atoms or elements in the periodic table gain stability by having eight electrons in their valence shell. They do so it by gaining, sharing or losing electrons. This is how they follow octet rule. They attain the electronic configuration of nearest noble gas

Q.62. Which electrons are involved in chemical bonding?

Ans. Only the electrons present in the valence shell of an atom are involved in chemical bonding. All the other electrons do not take part in chemical bonding

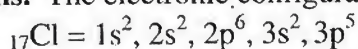
Q.63. Why does group 1 elements prefer to combine with group 17 elements?

Ans. Group 1 elements are good losers of electrons and have low ionization energies. Group 17 elements are good gainers of electrons and have high electron affinities. Therefore, as

these parameters favor the formation of bond between the two a strong ionic bond is formed between group 1 and group 17 elements

Q.64. Why chlorine can accept only one electron?

Ans. The electronic configuration of chlorine is



It can gain a maximum of one electron because it follows octet rule and can have a maximum of eight electrons in its valence shell.

Q.65. Give the electronic configuration of carbon atom

Ans. $_{6}\text{C} = 1s^2, 2s^2, 2p^2$

Q.66. What type of elements have tendency of sharing of electrons?

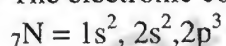
Ans. The elements with electronegativity values less than 1.7 show tendency of sharing electrons between them.

Q.67. If repulsive forces dominate to attractive forces, will a covalent bond form?

Ans. When the repulsive forces dominate the attractive forces, a bond will not be formed. This is due to the fact that repulsive forces account for increase in energy. Bond is formed when the atoms are at a state of minimum energy. As repulsive force will increase energy, so a covalent bond will not be formed.

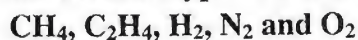
Q.68. Considering the electronic configuration of nitrogen atom, how many electrons are involved in bond formation and what type of covalent bond is formed?

Ans. The electronic configuration of nitrogen is



The valence shell of nitrogen is deficient of three electrons. These two nitrogen atoms share their three valence electrons each to form a triple covalent bond with three pairs of electrons and six electrons as a total shared.

Q.69. Point out the type of covalent bonds in the following molecules



Ans.

- i) CH₄ Single covalent bond
- ii) C₂H₄ Double covalent bond
- iii) H₂ Single covalent bond
- iv) N₂ Triple covalent bond
- v) O₂ Double covalent bond

Q.70. What is lone pair? How many lone pairs of electrons are present in nitrogen and ammonia?

Ans. The pair of electrons in the valence shell of an atom which does not take part in chemical bonding is called lone pair electrons.

In nitrogen there are two lone pairs and on each atom a lone pair is present. In ammonia, there is only one lone pair present on nitrogen atom while hydrogen does not have any lone pair.

Q.71. Why is the BF_3 electron deficient?

Ans. Boron has the electronic configuration as $1s^2 2s^2 2p^1$. This means that it needs five more electrons to be stabilized. In BF_3 it shares three electrons, each with one fluorine atom and thus attains six electrons in its valence shell. It still retains the tendency to gain two more electrons and therefore remains electron deficient.

Q.72. What types of electron pairs make a molecule good donor?

Ans. Lone pair of electrons makes a molecule a good donor. Since, they are not involved in bonding, so they can be used to form further bonds e.g., In ammonia, there is one lone pair on nitrogen which forms a coordinate covalent bond with another hydrogen forming ammonium ion.

Q.73. What is the difference between bonded and lone pair of electron and how many bonded pair of electrons is present in NH_3 molecule?

Ans. Valence shell electron pair involved in chemical bonding is a bond pair and one not involved is the lone pair of electrons and can form further bonds in certain cases. Three pairs of bonded electrons are present in NH_3 as there are three single covalent bonds in ammonia molecule between one nitrogen and three hydrogen atoms.

Q.74. Why does oxygen molecule not form a polar covalent bond?

Ans. In oxygen molecule (O_2) two oxygen atoms are covalently bonded to each other. As the atoms are similar, the electronegativity difference is zero, and the electron pairs are equally shared between them. Hence, there is no polarity in the bond.

Q.75. Why water molecule form a polar covalent bond?

Ans. Oxygen is a highly electronegative atom as compared to hydrogen. So, during the mutual sharing, the electron pair is attracted more towards oxygen and it acquires a partial negative charge and a partial positive charge develops on hydrogen. Hence, poles are created and the covalent bond becomes polar.

Q.76. What type of elements form metallic bonds?

Ans. Metallic bonds consist of sea of mobile electrons with positive ions. They are present in elements which have loosely bound electrons that do not remain in the valence shell and leave the atom to form a sea of electrons. Such a structure is observed usually in metals e.g., sodium, iron in metals.

Q.77. Why in metals the hold of nucleus over the outermost electrons is weak? Give reason.

Ans. The hold of nucleus on the outermost electrons in metals is very weak because of the increased screening effect or shielding effect between the intervening electrons which tend to decrease the force of attraction between nucleus and the electrons. Distance also plays the same role. As the electrons are at a greater distance from nucleus, the force of attraction becomes weak.

Q78. Why the electrons move freely in metals?

Ans. Because, the hold of nucleus over the outermost electrons is weak because of large sized atoms and greater number of shells in between nucleus and valence electrons. Furthermore, because of low ionization potentials, metals have the tendency to lose their outer electrons easily. Resultantly, these loose or free electrons of all metal atoms move freely in free space between atoms of a metal.

Q79. Which types of electrons are responsible for holding the atom together in metals?

Ans. The mobile electrons are responsible for holding the atoms of metals together forming a metallic bond.

Q80. Why a dipole develops in a molecule?

Ans. The unequal sharing of electrons between two different types of atoms make one end of molecule slightly positive and other end slightly negatively charged. Hence a dipole develops in a molecule.

Q81. What do you mean by dipole induced forces?

Ans. The positive end of polar molecule attracts the mobile electrons of the nearby non-polar molecule. In this way polarity is introduced in non-polar molecule and both become dipoles. These forces are called dipole induced forces.

Q82. Why dipole forces of attraction are not found in halogen molecules?

Ans. Halogen molecules form a non-polar covalent bond between them. In order to make non-polar bonds, no electronegative difference of elements is required, due to which dipole forces do not formed in halogen molecules.

Q83. What types of attraction forces exist between HCl molecules?

Ans. Weak intermolecular forces exist between HCl molecules.

Q84. Why ionic compounds have high melting and boiling points?

Ans. As ionic compounds are made up of positive and negative ions, there exist strong electrostatic forces of attraction between oppositely charged ions. So, a great amount of energy is required to break these forces, therefore ionic compounds have high melting and boiling points.

Q85. Why ionic compounds are easily soluble in water?

Ans. Water has high dielectric constant that weakens the attraction between the ions of ionic compounds due to which they are easily soluble in water

Q86. What type of attractive forces exists in ionic compounds?

Ans. Ionic bond exists in ionic compounds.

Q87. Why the covalent compounds of bigger size molecules have high melting points?

Ans. Bigger molecules with three dimensional bonding forms covalent crystals which are very stable and hard due to which they have high melting and boiling points.

Q88. How much there is electronegativity difference between the following pair of elements (atoms)? Predict the nature of the bond between them

- a) H and Cl b) H and Na c) Na and I d) K and Cl

Ans.

- a) H and Cl
Covalent bond H=2.2 Cl=3.2 Difference = $3.2 - 2.2 = 1.0$
- b) H and Na
Ionic bond H=2.1 Na=0.9 Difference = $2.1 - 0.9 = 1.2$
- c) Na and I
Ionic bond Na=0.9 I= 2.5 Difference = $2.5 - 0.9 = 1.6$
- d) K and Cl
Ionic bond K=0.8 Cl=3.2 Difference = $3.2 - 0.8 = 2.4$

Multiple Choice Questions

1. Which of the following is a building block of matter?

- (a) Atom (b) Molecule
(b) Element (d) Compound

2. The forces responsible for binding the atoms together in a molecule are called

- (a) Hydrogen bond
(b) Ionic bond
(c) Chemical bond
(d) Covalent bond

3. Atoms achieve stability by attaining electronic configuration of

- (a) Alkali metals
(b) Inert gases
(c) Alkaline earth metals
(d) Coinage metals

4. Attaining two electrons in the valence shell is called

- (a) Duplet rule (b) Triplet rule
(c) Octet rule (d) All of them

5. All the noble gases have their valence electrons

- (a) Partially filled
(b) Completely filled
(c) Less than 2
(d) More than 2

6. Noble gases are non-reactive, because they do not

- (a) Gain electrons
(b) Lose electrons
(c) Share electrons
(d) All of them

7. Every atom has a natural tendency to achieve electrons in its valence shell

- (a) 2 or 6 (b) 2 or 4
(c) 2 or 8 (d) 2 or 10

8. The position of an atom in the periodic table indicates its

- (a) Period number
(b) Group number
(c) Number of neutrons

(d) Number of electrons

9. How many valence shell electrons are there in group I elements?

- (a) One (b) Two
(c) Three (d) Four

10. Mode of reaction depends upon its

- (a) Number of valence shell electrons
(b) Number of shells
(c) Number of neutrons
(d) Atomic size

11. Hydrogen and helium follows

- (a) Octet rule (b) Duplet rule
(c) Triplet rule (d) none of them

12. The formation of ionic bond between two ions is due to

- (a) Hydrogen bonding
(b) Metallic forces
(c) Electrostatic forces
(d) All of them

13. Which force becomes operative, when two atoms come closer to each other?

- (a) Attractive forces
(b) Repulsive forces
(c) Both a and b
(d) None of them

14. The formation of a chemical bond is a result of dominant net

- (a) Attractive forces
(b) Repulsive forces
(c) Both of them
(d) None of them

15. A molecule is formed, when energy of a system

- (a) Remains same (b) Decreased
(c) Increased
(d) Shows variability

16. The valence electrons, which are involved in chemical bonding, are termed as

- (a) Lone pair electrons
(b) Bonding electrons
(c) High energy electrons
(d) Low energy electrons

17. Which group of the periodic table have the tendency to gain electrons

- (a) Group 1 (b) Group 18
(c) Group 2 (d) Group 17

18. The electronegative elements have

- (a) High electron affinities
(b) Low electron affinities
(c) Large atomic sizes
(d) High melting points

19. A bond formed due to complete transfer of electrons from one atom to another is called

- (a) Covalent bond
(b) Hydrogen bond
(c) Ionic bond
(d) Metallic bond

20. The electronic configuration of sodium atom is

- (a) $1s^2 2s^2 2p^6$
(b) $1s^2 2s^2 2p^5$
(c) $1s^2 2s^2 2p^6 3s^2$
(d) $1s^2 2s^2 2p^6 3s^1$

21. How many electrons are there in the valence shell of sodium atom?

- (a) One (b) Two
(c) Three (d) Four

22. The electropositive elements have the tendency to

- (a) Gain electrons
(b) Lose electrons

- (c) Share electron
(d) All of them
23. How many valence shell electrons are there in Na^+ ion?
(a) 8 (b) 9
(c) 10 (d) 11
24. During the formation of ionic bond, heat
(a) Absorbed (b) Released
(c) Remains same (d) Both a or b
25. Which type of attractive forces are present in ionic compounds?
(a) Covalent bonds
(b) Coordinate covalent bonds
(c) Metallic bonds
(d) None of them
26. Covalent bond is most commonly found between the elements of group
(a) 13 to 17 (b) 1 to 13
(c) 16-18 (d) 15-18
27. A bond formed by the mutual sharing of an electron pair is called
(a) Ionic bond
(b) Covalent bond
(c) Coordinate covalent bond
(d) Metallic bond
28. The electrons that pair up to form a chemical bond are called
(a) Lone pair electrons
(b) Bond pair electrons
(c) High energy electrons
(d) Low energy electrons
29. A covalent bond formed by the mutual sharing of two pairs of electrons between bonded atoms is called
(a) Single covalent bond
(b) Double covalent bond

- (c) Triple covalent bond
(d) Polar covalent bond
30. Which molecule contains a single covalent bond?
(a) CH_4 (b) C_2H_4
(c) C_2H_2 (d) O_2
31. Nitrogen molecule contain
(a) Polar covalent bond
(b) Single covalent bond
(c) Double covalent bond
(d) Triple covalent bond
32. How many electrons are involved in the formation of single covalent bond?
(a) One (b) Two
(c) Three (d) Four
33. Dative covalent bond is also known as
(a) Coordinate covalent bond
(b) Covalent bond (c) Ionic bond
(d) Metallic bond
34. How many lone pairs are present on nitrogen in ammonia molecule?
(a) One (b) Two
(c) Three (d) Four
35. Which type of bond is present between NH_3 and BF_3 ?
(a) Covalent bond
(b) Coordinate covalent bond
(c) Ionic bond
(d) Metallic bond
36. A covalent bond formed by two similar atoms is known as
(a) Polar covalent bond
(b) Non-polar covalent bond
(c) Metallic bond
(d) Double covalent bond

37. Which of the following is an example of polar covalent compound?

- (a) HCl (b) Cl₂
- (c) O₂ (d) H₂

38. The difference between electronegativities of hydrogen and chlorine

- (a) 1.0 (b) 2.0
- (c) 3.0 (d) 0.9

39. The electronegativity of hydrogen atom is

- (a) 2.0 (b) 2.2
- (c) 3.0 (d) 2.1

40. Which sign indicates partial positive and partial negative charge?

- (a) Sigma (b) Pi
- (c) Delta (d) none of them

41. The nature of a chemical bond can be predicted by using

- (a) Electron affinity values
- (b) Electronegative values
- (c) Ionization energy values
- (d) All of them

42. A covalent bond is formed by the elements having

- (a) Low electronegative values
- (b) High electronegative values
- (c) Comparable electronegative values
- (d) High electron affinity values

43. If the difference of electronegativities between two elements is more than 1.7, the bond will be

- (a) Ionic bond
- (b) Single Covalent bond
- (c) Double Covalent bond

(d) Metallic bond

44. If the difference of electronegativities between two elements is less than 1.7, the bond will be

- (a) Ionic bond
- (b) Covalent bond
- (c) Metallic bond
- (d) All of them

45. In metals, the hold of nucleus over the valence shell electrons is weak due to

- (a) Large sized atoms
- (b) High ionization energies
- (c) High electron affinities
- (d) All of them

46. Metals have the tendency to lose electrons due to

- (a) High ionization energy
- (b) Low electron affinity
- (c) Low ionization energy
- (d) None of them

47. The mobile electrons are responsible for holding the atoms of metals together, forming a

- (a) Ionic bond
- (b) Covalent bond
- (c) Hydrogen bond
- (d) Metallic bond

48. Which of the following is the weakest bond amongst them?

- (a) Covalent bonding
- (b) Intermolecular forces
- (c) Ionic bonding
- (d) Metallic bond

49. The energy required to break the intermolecular forces between one mole

of liquid hydrogen chloride molecule to convert it into gas is

- (a) 22 kJ (b) 32 kJ
(c) 132 kJ (d) 17 kJ

50. The energy required to break the chemical bond between hydrogen and chlorine atoms in 1 mole of hydrogen chloride is

- (a) 320 kJ (b) 430 kJ
(c) 365 kJ (d) 410 kJ

51. Intermolecular forces are collectively known as

- (a) Vander Waals forces
(b) Electrostatic forces
(c) Adhesive forces
(d) Dipole-dipole forces

52. Hydrogen bonding is always found in

- (a) Non-polar molecules
(b) Polar molecules
(c) homoatomic molecules
(d) All of them

53. The force of attraction between water molecules is

- (a) Ionic bonding
(b) Covalent bonding
(c) Hydrogen bonding
(d) Coordinate covalent bonding

54. The boiling point of water is

- (a) 0 °C (b) 35 °C
(c) 100 °C (d) 25 °C

55. The boiling point of alcohol is

- (a) 44 °C (b) 19 °C
(c) 53 °C (d) 78 °C

56. Water has high boiling points as compared to alcohol due to

- (a) Hydrogen bonding

(b) High vapour pressure

(c) Low density

(d) High surface tension

57. The density of ice at 0°C is

- (a) 0.917 g/cm³ (b) 1.24 g/cm³
(c) 1.7 g/cm³ (d) 2.17 g/cm³

58. The density of water at 0°C is

- (a) 2.0 g/cm³ (b) 1.00 g/cm³
(c) 0.70 g/cm³ (d) 1.17 g/cm³

59. The compounds formed by oppositely charges are known as

- (a) Non-polar Covalent compounds
(b) Ionic compounds
(c) Metallic solids
(d) None of them

60. Ionic compounds are good conductors of electricity in

- (a) Solid state (b) Molten state
(c) Solution (d) Both b or c

61. Ionic compounds have

- (a) High melting and boiling points
(b) High melting and low boiling points
(c) Low melting and high boiling points
(d) Low melting and boiling points

62. The melting point of NaCl is

- (a) 318 °C (b) 1000 °C
(c) 510 °C (d) 800 °C

63. The boiling point of NaCl is

- (a) 2000 °C (b) 1413 °C
(c) 1215 °C (d) 1510 °C

64. Which of the following is an example of a covalent compound?

- (a) C₆H₁₂O₆ (b) CH₄
(c) H₂SO₄ (d) All of them

65. At room temperature, higher molecular mass covalent compounds are

- (a) Solids (b) Liquids
- (c) Gases (d) All of them

66. Non-polar compounds are insoluble in

- (a) Water (b) Benzene
- (c) Ether (d) Alcohol

67. The electronegative value of fluorine is

- (a) 1.0 (b) 2.0
- (c) 3.0 (d) 4.0

68. The electronegativity value of atoms is given by which scale?

- (a) PH (b) Pauling
- (c) POH (d) None of them

69. Which of the following do not show ions in water?

- (a) Polar Covalent compounds
- (b) Ionic compounds
- (c) Coordinate covalent compounds
- (d) All of them

70. Malleability is the property by virtue of which a metal can be drawn into

- (a) Sheets (b) Wires
- (c) Rods (d) Plates

71. Metals usually have

- (a) High ionization energy
- (b) Low ionization energy
- (c) High electron affinity
- (d) High electronegativity

72. Metals are good conductors of heat and electricity in solid and liquid state due to

- (a) Mobile electrons
- (b) Lone pair electrons

- (c) Bond pair electrons
- (d) All of them

73. Which type of adhesives is less expensive to produce?

- (a) Synthetic (b) Natural
- (c) Both a and b (d) none of them

74. Epoxy adhesives can be made

- (a) Flexible or rigid
- (b) Transparent or opaque
- (c) Coloured
- (d) All of them

75. Epoxy adhesives are

- (a) Good heat resistant
- (b) Good chemical resistant
- (c) Both a and b
- (d) None of them

76. Epoxy adhesives are stable to heat up to a temperature of

- (a) 177 °C (b) 225 °C
- (c) 320 °C (d) 135 °C

77. Epoxy adhesives are also known as

- (a) Medical adhesives
- (b) Engineering adhesives
- (c) Surgical adhesives
- (d) All of them

78. An atom having six electrons in its valence shell will achieve noble gas electronic configuration by

- (a) Gaining one electron
- (b) Losing all electrons
- (c) Gaining two electrons
- (d) Losing two electrons

79. Considering the electronic configuration of atoms which atom with the given atomic number will be the most stable one?

- (a) 6 (b) 8
- (c) 10 (d) 12

80. Octet rule is

- (a) Description of eight electrons
- (b) Picture of electronic configuration
- (c) Pattern of electronic configuration
- (d) Attaining of eight electrons

81. Transfer of electrons between elements result in

- (a) Metallic bonding
- (b) Ionic bonding
- (c) Covalent bonding
- (d) Coordinate covalent bonding

82. When an electronegative element combine with electropositive element the type of bonding is

- (a) Covalent
- (b) Ionic
- (c) Polar covalent
- (d) Coordinate covalent

83. A bond formed between two non-metals is expected to be

- (a) Covalent
- (b) Ionic
- (c) Coordinate covalent
- (d) Metallic

84. A bond pair in covalent molecules usually has

- (a) One electron
- (b) Two electrons
- (c) Three electrons
- (d) Four electrons

85. Which of the following compounds is non-directional in its bonding?

- (a) CH_4
- (b) KBr
- (c) CO_2
- (d) H_2O

86. Ice floats on water because

- (a) Ice is denser than water
- (b) Ice is crystalline in nature
- (c) Water is denser than ice
- (d) Water molecules move randomly

87. Covalent bond involves the

- (a) Donation of electrons
- (b) Acceptance of electrons
- (c) Sharing of electrons
- (d) Repulsion of electrons

88. How many covalent bonds does C_2H_2 molecule have?

- (a) Two
- (b) Three
- (c) Four
- (d) Five

89. Triple covalent bond involves how many numbers of electrons?

- (a) Eight
- (b) Six
- (c) Four
- (d) only three

90. Which pair of the molecules has same type of covalent bonds?

- (a) O_2 and HCl
- (b) O_2 and N_2
- (c) O_2 and C_2H_4
- (d) O_2 and C_2H_2

91. Identify the compound which is not soluble in water

- (a) C_6H_6
- (b) NaCl
- (c) KBr
- (d) MgCl_2

92. Which of the following is an electron deficient molecule?

- (a) NH_3
- (b) BF_3
- (c) N_2
- (d) O_2

93. Identify which pair has polar covalent bonds

- (a) O_2 and Cl_2
- (b) H_2O and N_2
- (c) H_2O and C_2H_2
- (d) H_2O and HCl

94. Which of the following is the weakest force among the atoms?

- (a) Ionic forces
- (b) Metallic forces

(c) Intermolecular forces

(d) Covalent forces

95. Atoms react with each other because

(a) They are attracted to each other

(b) They are short of electrons

(c) They want to attain stability

(d) They want to disperse

Answer Key

1.	a	2.	c	3.	b	4.	a	5.	b
6.	d	7.	c	8.	b	9.	a	10.	a
11.	b	12.	c	13.	c	14.	a	15.	b
16.	b	17.	d	18.	a	19.	c	20.	d
21.	a	22.	b	23.	a	24.	b	25.	d
26.	a	27.	b	28.	b	29.	b	30.	a
31.	d	32.	b	33.	a	34.	a	35.	b
36.	b	37.	a	38.	a	39.	b	40.	c
41.	b	42.	c	43.	a	44.	b	45.	a
46.	c	47.	d	48.	b	49.	d	50.	b
51.	a	52.	b	53.	c	54.	c	55.	d
56.	a	57.	a	58.	b	59.	b	60.	d
61.	a	62.	d	63.	b	64.	d	65.	a
66.	a	67.	d	68.	b	69.	c	70.	a
71.	b	72.	a	73.	b	74.	a	75.	b
76.	a	77.	b	78.	c	79.	c	80.	d
81.	b	82.	b	83.	a	84.	b	85.	b
86.	c	87.	c	88.	d	89.	b	90.	c
91.	a	92.	b	93.	d	94.	d	95.	c